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# Endogenous energy efficiency improvement

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## List of abbreviations

CREST	Competence Center for Research in Energy, Society, Transition
EEl	Energy efficiency improvement
LEURE	EPFL Laboratory for Environmental and Urban Economics
PhD	Doctorate
SCCER	Swiss competence center in energy research
SNF	Swiss National Science Foundation



## Project goals

Future energy use depends on energy efficiency improvement (EEI). In most energy and climate policies analyses, the speed and extent of EEI is assumed autonomous, despite policies designed to foster innovation. This project will make EEI responsive yet fraught with barriers to innovation, in a complete simulation model of the Swiss economy and show what difference that makes for energy policies in housing and in one industry sector.

## Summary

The work on this project started in August 2017. It involved reviewing the concept of endogenous technical progress, in particular in energy efficiency, and common modelling representations thereof. It also involved identifying and assessing the existing data on housing and its energy efficiency standards in Switzerland. Finally, the criteria for selecting the industrial sector were defined and a pre-selection made.

## Work undertaken and findings obtained

The project started on time in August with the hiring of the PhD student, Sergey Arzoyan. We are now in the phase of literature review, data collection and concretisation of approaches. Above and beyond the information given in the proposal, we have made the following progress or have developed the following additional concepts, respectively.

### Housing

We are scanning the literature in Switzerland and internationally for data that is useful for the transition matrix. As basis we used the literature as given in the proposal and references therein. Also, we are planning to start coding the transition matrix parallel to the data collection effort, as modelling can also start with dummy variables. If data is not directly available, we will use indirect sources, in order to make approximation (e.g. one could use data on thermal transmittance to estimate the energy efficiency of buildings).

### Industry

We made clarification which data sources are available: For big companies we could use “lean case studies” and collect data directly from companies. Alternatively, we could use data from the Emissions Trading scheme. We defined the selection criteria: high energy intensity, homogeneous product, data availability and past and future potential of EEI. Possible sectors to be evaluated are steel, cement, pulp&paper, chemical.

For SME (metal processing, hotel, etc.) we can use the data from the Federal Office of Energy on energy improvement targets, which would be made available by the FOE for this project (we obtained a positive answer on our request from Mr. Scheiddegger). This would give us a larger sample size but also has the disadvantage that we cannot control the definition of energy efficiency (as it is given in the data). These data also contain expenditure for energy efficiency improvements.

### Modelling

We are in the phase of literature review, especially on how to model the industry sector (as for housing we already have a model in mind). Endogenous EEI and barriers may be included by hard or soft coupling. Hard coupling makes the model easier to solve, yet the separate model has to be consistent with GEMINI-E3. Hard coupling would be preferable.



## National cooperation

None at this stage, but we are well aware of research conducted in SCCER CREST and by TEP Energy GmbH and could establish connections. First contacts were also made with the parallel project of Lucas Bretschger.

## International cooperation

We participate in a Horizon 2020 project called EUCalc – "EU Calculator: Trade-offs and pathways towards sustainable and low-carbon European societies". It is a response to the topic "Managing technology transition" of the Horizon 2020 call. EUCalc will provide a Transition Pathways Explorer, for which technical progress in general and energy efficiency improvement in particular will be important components. The project started in November 2016 and will last until October 2019.

## Evaluation 2017 and outlook for 2018

The project is in a very early phase. Obtaining good multi-year data on housing and its energy use proved a little more challenging than expected, so we are delayed by two months with completing this first task. On the other hand, progress was made in identifying the possible industry sector to be modelled in year 2 and possible sources of data. Once the data for the housing stock are obtained, we will be able to test different forms of transition dynamics next year. We will also benefit from the collaboration with a new research project starting in January on distinguishing how past EEI of the different sectors of Switzerland can be attributed to technical innovation or behavioral changes respectively. This is an Ambizione project funded by the SNF for 3 years and led by Vincent Moreau, who will join LEURE with a PhD student in January 2018.

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